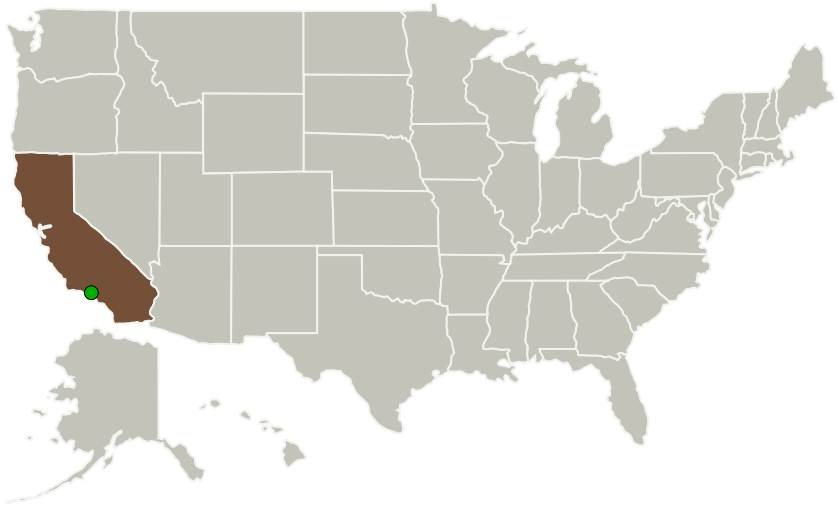
Ductile Tungsten-Rhenium Coating for Long-Term Protection of Nuclear-Thermal Rocket Fuel, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

In conjunction with Sandia National Laboratories, Ultramet previously demonstrated the feasibility of using low-density, high specific stiffness open-cell foams for creation of innovative fuel elements for use in space nuclear reactors. Highly porous and structural foam material was produced by chemical vapor infiltration of uranium, niobium, and zirconium carbides into a foam matrix. The foam structure and versatility in fuel composition were used to take advantage of the potential for high power density, high thermal efficiency, and small core size. The lifetime of this fuel material, as well as current pellet-type fuels in industry, would benefit greatly from the development of an impermeable surface coating that would prevent hydrogen attack of the underlying fuel and contain fission products for extended periods. Tungsten is an attractive surface coating in terms of temperature capability, hydrogen compatibility, and neutronics, but is inherently brittle and prone to cracking when subjected to modest mechanical or thermal stress. Ultramet has extensive experience in development of tungsten alloys with improved ductility for applications including ballistic penetrators and liners for solid rocket motor throats. In this project, Ultramet will develop the processing for deposition of thin tungsten-rhenium alloy coatings on open-cell foam fuel elements. Components will be exposed to high temperature hydrogen at Ultramet, followed by surface and cross-sectional coating characterization. Sandia will perform preliminary modeling experiments to determine the optimal concentration of rhenium in the coating and coating thickness. The potential exists to utilize the proposed containment coating over a variety of high-efficiency open-cell foam fuels including carbides and cermets.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Ultramet	Lead Organization	Industry	Pacoima, California
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138108)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ultramet

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

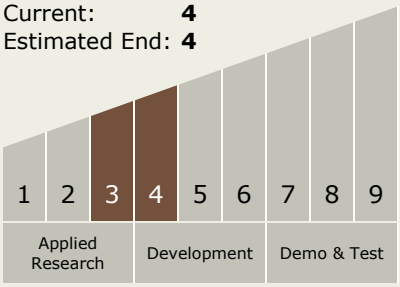
Carlos Torrez

Principal Investigator:

Brian E Williams

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.4 Advanced Propulsion
    - TX01.4.4 Other Advanced Propulsion Approaches

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System